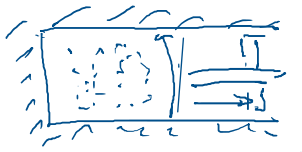


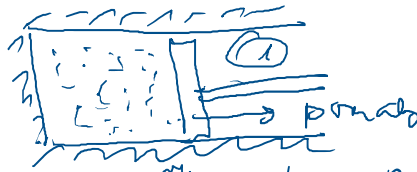
Teplo

$$\Delta E = ? \quad \Delta W = 0$$

$$\Delta Q = 0$$

$$\downarrow$$

$$\Delta E = 0$$



$$\textcircled{1} \Delta W > 0 \quad \textcircled{2} \Delta W = 0$$

$$\Delta Q = 0 \quad \Delta Q > 0$$

$$\Delta E < 0 \quad \Delta E > 0$$

$$T \rightarrow \quad \Delta T > 0$$

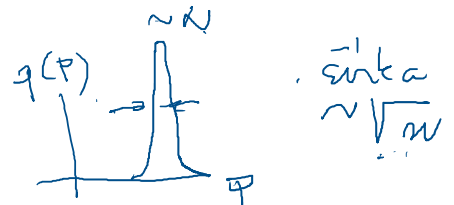
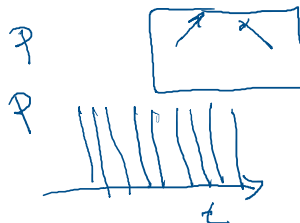
$$T \nearrow$$

Stanové funkcie

Macroscopicke veličiny, kt. určujú stav systému

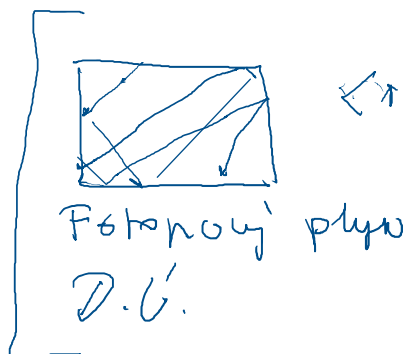
$$T, P, V, B, E, \dots$$

$$T(P, V, N)$$



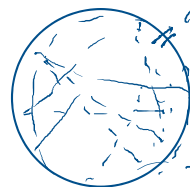
$$\text{šírka} \sim \sqrt{N}$$

$$\frac{\delta P}{P} \sim \frac{1}{\sqrt{N}} \sim 10^{-13}$$

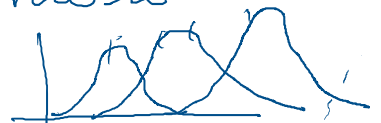


$$\langle v^2 \rangle = c^2$$

$$p = \frac{h\nu}{c}$$

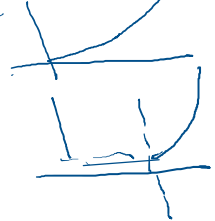


Žiarenie čierneho telesá



$$E = \sigma T^4$$

$$\delta E = h\nu \text{ fotón}$$

Druhá veta termodynamiky

Multipličita



$$N_1 + N_2 = N$$

Stanová relácia (N_1, N_2)
Hlabosť

Mikrostav

$$\{1: 1, 2: 1, 3: 2, 4: 1, 5: 2, \dots, N: 1\}$$

$$P(\text{molekula } i \text{ je } \uparrow) = \frac{1}{2}$$

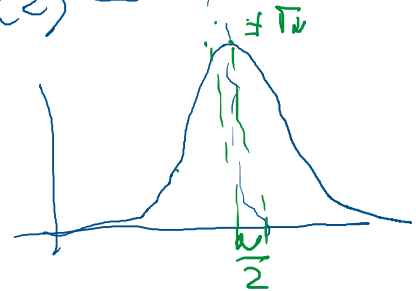
$$P(\uparrow \text{ je } k \text{ molekúl}) = \binom{N}{k} \cdot \left(\frac{1}{2}\right)^k \left(\frac{1}{2}\right)^{N-k} = \frac{1}{2^N} \binom{N}{k}$$

$$(1 + 1)^N = \sum_{k=0}^N \binom{N}{k} (1)^k (1)^{N-k}$$

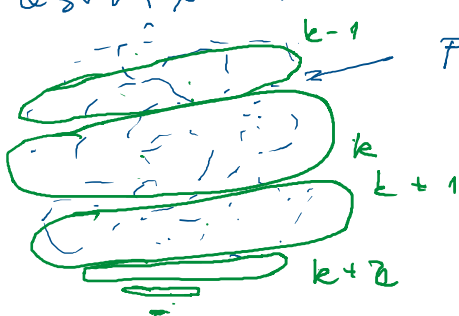
Binomické rozdelenie:

$$P(k, N-k) = \frac{1}{2^N} \binom{N}{k}$$

$$\sum_k P(k, N-k) = 1$$



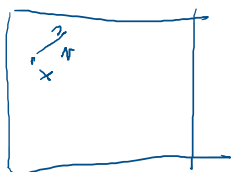
Prírodný priestor



$$P = \frac{1}{2a}$$

$$\frac{N}{2} \pm \sqrt{\frac{N}{4}}$$

System prirodzene prechádza do stavu s najväčšou multiplicitou.



$$\vec{r} = (x, y, z)$$

$$\vec{r} = (r_x, r_y, r_z)$$

Fázový priestor

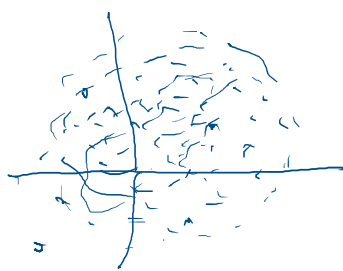
$$N(\vec{r}, \vec{p})$$

$$\vec{p} = -\frac{\partial H}{\partial \vec{r}}$$

$$\vec{r} = \frac{\partial H}{\partial \vec{p}}$$

Hamiltonove.

6N-rozmerný systém



Hamiltonova rovnice

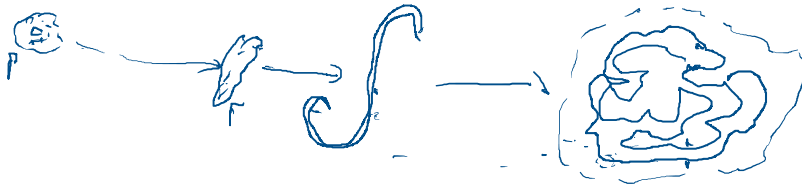
$$H = \frac{p^2}{2m} + V(x)$$

$$\dot{p} = - \frac{\partial H}{\partial x} = - \frac{\partial V}{\partial x}$$

$$\dot{x} = \frac{\partial H}{\partial p} = \frac{p}{m}$$

Liouvilleova věta:

Fázový objem systému je konstantní



D.Ú.

N molekul O_2 sa nachádza v nádobe s pístom. Stlačím plyn na $\frac{1}{3}$ pôvodného objemu a súčasne plyn zahrejeme tak, že jeho teplota narastie 6-násobne.

Ako sa zmení:

1. Tlak
2. stredná rýchlosť molekúl
3. počet nárazov mol. na jedn. plochy za jedn. čas.

Piatok 14⁰⁰.